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Crank device

The present invention relates to a solution providing a crank mechanism giving an elliptical orbit to pedal or platform driven equipment.

The invention will mainly be shown and described in relation to training equipment, though it should be understood that the invention relates to all pedal driven equipment and machinery.

In the fitness industry there is a wish for training equipment, which simulate a movement of the leg and foot, as it naturally would move when walking, running and or skiing. On the market today there is equipment aiming to do so with more ore less success, often called elliptical trainers or cross trainers. A typical trainer of this sort has a crank fixed with horizontal bars having platform or pedals. The bars are linked to vertical handles, which moves with the bars. The crank has or is connected to a flywheel and a brake mechanism adjusting the force driving the machine. Worth mentioning as examples are products from Tunturi, LifeFitness, Icon and Precor. There are hundreds of patents and patent applications regarding elliptical trainers and cross trainers. For example US 5792026 - Maresh and Stearns and US 6090013 – Eschenbach. These inventors have many publications regarding elliptical trainers and cross trainers but the author feels that it would be redundant to list all their patents and patent applications, not to mention all other inventors working in this field. These patents are found under International classification group A63B.

Regarding elliptical machines no publication shows the solution achieving the optimal elliptical movement as the invention in question does. The invention solves the orbit of the pedals and or platforms quite differently than the above mention art. Training machines creating an orbit to pedals or platforms in an elliptical shape, are often built quite big to give the wanted stride length. They also often have big and many bars linked to each other and the trainers have limited means of adjustment of the stride length and orbit of the pedals.

The invention uses gears to give a crank arm a rotation at the one end linked position and the outer end of the crank and pedal a desired elliptical shaped orbit. Each crank

arm is divided in two parts. The outer crank arms has gears, toothed wheels, which revolves round each of a second pair of fixed gears linked together with a chain. The length of the crank arm decides the size of the orbit. The length can be fixed, manually adjustable or automatically adjustable dependent on speed or desired stride length. The invention in a typical version has a flywheel with brake means for adjusting the force needed driving the crank arms. This is preferred incorporated in a training machine, which will compete with the existing elliptical trainers or cross trainers. This kind of training machine can have a number of features as adjustable stride length and handles for arm movement.

The invention can also be used in a machine for creating force and or movement. The invention placed in a bicycle can replace the conventional crank. As the length of the crank arms change through a rotation the orientation of the ellipse is so that the crank arms longest place are where the force on the pedals is highest.

Further inventive steps are disclosed in the claims.

The technical characteristics of the invention will be described with reference to accompanying drawings, which illustrates preferred embodiments of the invention by example and in which:

Fig. 1a-c shows a side view, top view and a front view of the first embodiment

Fig. 2 shows a perspective view of the first embodiment

Fig. 3a-d shows side and front view and detail views of the flywheel and drive assembly within the first embodiment.

Fig. 4 shows a perspective view of the flywheel and drive assembly within the first embodiment.

Fig. 5a-b shows a variation of flywheel connection.

Fig. 6a-b shows the elliptical orbit of the pedals given by the first embodiment of the invention.

Fig. 7a-h shows the movement of the crank during a full orbit according to the first embodiment.

Fig. 8 illustrates the principle according to the inventions first embodiment.

Fig. 9 14 illustrates a variation according to the inventions first embodiment.

Fig. 10 show pedal or platform held in a horizontal position through a full elliptic orbit according to the invention second embodiment.

Fig. 11a-d show schematically transmission variations of the second embodiment.

Fig. 12a-b shows a side view and a front view of the preferred second embodiment.

Fig. 13 shows a side perspective of the preferred second embodiment.

Fig. 14a-b shows means for lengthening of crank arms.

Fig. 15a-b shows a solution as a combination of the invention shown on figures 11 and 14

Fig. 16 shows a flowchart of adjustable automatic stride control.

Fig. 17a-c show platform with tilt motion.

Fig. 18a-b show pedal with tilt motion.

Fig. 19a-c shows a training machine utilizing the invention with platforms and fixed handlebars,

Fig. 20a-c shows a training machine utilizing the invention with platforms and moving handles.

Fig. 21 show a bicycle utilizing the invention.

Fig. 1 and 2 show the assembly of the crank assembly according to the invention. On a frame 1 is mounted a crank assembly comprising a pair of two-part crank arms 2 and 3 rotate ably linked together at 4 and 5. The inner crank arms 6 and 7 are fixed together through an axle 8 (not shown). The outer crank arms 10 and 11 are fixed through axles 12 and 13 to gears 14 and 15 rotate ably through the inner crank arms. To the frame is fixed non-rotate able gears 16 and 17. The ratio between gears 12-13 and 16-17 is 1:2. Chains 18 and 19 connects the gears. The end portions of the outer cranks have pedals 20 and 21. To the axle 8 is fixed a wheel 22, which rotates when the crank is set in motion. As shown in fig. 3-4 a wheel 24 runs on the inside of wheel 22. The wheel 24 is connected to a wheel 25 via an axle 26 through a tension block 27 fixed to the frame. The tension of the wheel 24 to wheel 22 is adjusted by screws on the tension block. Round the axle 8 is freely rotate ably mounted a flywheel 30. A belt 31 connects the flywheel to wheel 25. As the crank arms are set in motion the flywheel is set in motion. The ratio between wheel 22 and 24 is in the area of 10-(3-1), but can be varied depending on the size and wanted speed of the flywheel. As shown in fig. 5a-b the flywheel can also be located outside the crank assembly. The flywheel will have means of braking. This is done using known art, here indicated on fig. 4 with number 34 where an electro-magnetic brake device is mounted. Other brake devices include using a variable tension belt round the flywheel or some kind of brake shoes.

The motion of the crank arms is shown in figures 6 and 7. As shown in fig. 6 the result of one rotation will give an elliptic orbit 40 at the pedal positions. The length of the outer crank arm, or fixing point of the pedal decides the size of travel as shown on fig.

7b where the fixing points for the pedals are indicated at 41 and 42. When setting the pedals and crank arms in motion, as indicated by arrow 43 on fig. 7 the fixed end of the outer crank arm will travel as indicated by arrow 44. This happens as a result of a rotating movement of the gears fastened to the other crank arm and their travel on the chains revolving round the fixed gears. The figures 7a-7h show the travel of the crank arms at 45% intervals through a full 360 orbit.

The first embodiment of the invention uses a chain 50 to transfer the crank arms 51 the desired motion as the principle fig. 8 illustrates, showing fixed gear 52 and the rotating gear 53 fixed to crank arm.

The motion can also be achieved by using gears, which directly interact as illustrated in fig. 9, which forms a variation of (second embodiment) of the invention. Gear 60 is fixed. Moving the crank arm 61 as indicated by arrow 62, rotates gear 63, which is fixed to the crank arm, and in turn rotates gear 64, which then revolves around gear 61. For the outer crank arm to revolve 360 degrees, the ratio between the inner gear and the outer gear must be 2:1.

Having the invention in a training machine which to use in a running position, may demand pedals, or platforms to stay in a horizontal position or other wanted angle during a full rotation of the crank. Fig. 10 shows pedal or platform 70 through a full orbit staying horizontal in all positions. The outer crank arm 75 have a first gear 77 attached to the pedal/platform axle which is connected to a second gear 78 attached to the outer crank axle through a chain 76. Gear 78 is connected through an axle to a gear 80 on the inside of the crank arms 75 and 79. Gear 80 is connected to a gear 82, which is fixed to the frame 84, through a chain 85. The ratio between the gears 77, 78, 80 and 82 is 1:1 as suggested in fig. 11a -b. This keeps the platform or pedal 70 at the same angle independent of the rotations of the crank arms. As shown in fig. 11c-d the chain drive is replaced by an axle 90 with conic gears 91 an 92 which connects with gear on pedal axle 94 which distributes a 1:1 rotation to the pedal axle from gear 95 connected through an axle and gears as shown in fig. 11a-b.

Fig. 12-13 show a second embodiment within the invention, which gives pedals or platforms a controlled angle through a rotation of the crank arms. The solution gives the same result as solution shown in fig. 11, but has two fixing positions for pedal or platform. Fig. 12 does however only show the one side of the construction.

As described for the embodiment shown in fig. 1 and 2 the crank device has an outer crank arm rotational fixed to an inner crank arm 101. A gear 103 is stationary fixed to the frame 105, which is linked to gear 106 through chain 108. Gear 106 is fixed to outer crank arm 100 via an axle rotational through inner crank arm 106. Ratio between gear 103 and 106 is 2:1. As shown in fig. 7 will movement of the outer crank arm turn gear 106 and move the fixing point between the two crank arms 110, on the chain round the fixed gear 103. A gear 112 is rotational fixed to the outer crank arm, but stationary fixed to the inner crank arm. Movement between the crank arms will make gear 112 rotate relative to the outer crank arm. This rotation is transferred to a gear 114 rotational fixed to the outer crank arm through a chain 115. The ratio between gears 112 to 114 is 1:2. Fixed in centre of gear 114 is gear 120 with a fixing point 121 for attachment of pedal or platform. The rotation of gear 114 makes gear 120 and fixed pedal or platform (not shown) rotate independently of the crank arms. It should be understood that the ratio shown in this embodiment is made for keeping pedal or platform in one position through a full rotation of the cranks, and changing the ratios will angle the pedal or platform differently. To the outer crank arm a second fixing point 123 for pedal or platform is placed in the centre of gear 122 rotational relative to outer crank arm. Between gear 120 and gear 122 is a chain 124, which in ratio 1:1 transfers rotation from gear 120 to 122 and attached pedal or platform. This gives this gear device two fixing points for pedals or platforms, fixing point 121 giving a flatter elliptical orbit than fixing point 123.

Fig 13 show in perspective the crank device described accordingly in fig. 12.

In a training machine utilizing the invention an adjustment of the stride length is desirable. This can be done as explained above in connection with fig. 6, but methods achieving this during a motion will be explained using fig. 14. Fig. 14 and 15 show how the crank arm can be made for both having controlled pedal angle and adjustment of

crank arm length. Fig. 14a show the outer crank arms 130 and 131 with pedals 132 and 133 fixed to means for adjusting the length of the crank arms. The means illustrated are cylinders 134 and 135. Using pressurized oil and return springs the cylinders can expand and extract giving a variation of the stride length 136. Having sensors for measuring the speed during rotation of the crank coupled to means for signalling to a pump, the oil pressure can be increased to give a stride dependent on speed. Short stride for low speed and long stride at high speed. The mechanics of this is not in detail shown on the figure but should be of known art to anyone skilled in the art.

Variation of the stride length is also possible using treaded bolts which when given a rotation moves the outer ends of the crank arms. As illustrated in fig. 11b, the bolts 138 and 139 can be fitted with electric engines 140 and 141, which can rotate the bolts when given the wanted signal. A sensor measures the speed of the crank arms signalling the engines for executing wanted length of the cranks.

Fig. 15a-b shows a variation of adjustment of crank length for a crank device as shown in fig. 11b-c. The outer crank arm 150 consists of two parts 151 and 152 which when slid relative to each other as indicated by arrow 153, adjusts the length of the crank arm. An axle 155 with gears as shown in fig. 11 is telescopic and will adjust with the length of the crank.

Fig. 16 shows a flow chart illustrating a system for automatic, or user defined stride control and adjustment. Speed of the cranks can be measured by a sensor 160 for example directly on the crank axle, axle mounted wheel, flywheel or other parts rotating as result of crank axle rotation, illustrated by 161.

The sensor sends signals to a microprocessor or CPU 162, which is programmed, to means for adjusting cranks 163 and 164. Numbers 165 and 166 indicates engines or pumps. Numbers 167 and 168 indicates sensors, which measures the length of the cranks. Means for operating is provided in form of button clusters with display or of a touchscreen, marked 169. Run by a program in the CPU can display choices on a screen, for example adjustment of the stride 170 or automatic adjustment of stride dependent on speed 171.

The crank device will have means for supporting the foot of a user. Depending on what type of training machine the crank device is mounted in, either platforms or pedals are fixed to the crank arms. To gain a proprioseptic training flexible platforms or pedals should be mounted on the crank device.

Fig. 17 shows a type of platform, which has means of tilting. An upper platform part 180 is fixed to a frame 181 through axles 183 and 184. The frame has an axle or bolt 185 for fixing to crank arms. As illustrated in fig. 17c the platforms upper part is tilt able transverse to the axle 185. The platforms upper part is made firm through twisting a bolt 188 parallel to the axle 185, the bolt having the same dimension as the gap between the upper platform part and the frame.

Fig 18. show a pedal with tilt motion. The pedal body 190 has an axle 191 which to fasten to a crank arm. To the pedal body a footrest 192 is tilt able fixed 90° to axle 191. This gives a pedal with one traditional stable pedal side 193 and an unstable tilt able side 194.

As mentioned above the invention may be utilized in a number of pedal driven machines. Fig. 19 shows a training machine utilizing the invention with platforms 200 and 201 and fixed handles 203 and 204. The crank device 205 shown is described according to fig. 12 but it should be understood the any of the embodiments or variations thereof, shown in this application could be utilized in such a machine. This machine is a compact unit and the frame is constructed so to fold, fig. 19d, and thereby save space when in storage.

Fig. 20a-c shows a training machine utilizing the invention with platforms and moving handles. The figure is purely schematically and shows how prior art regarding moving handles can be incorporated with the crank devices according the invention. The handles 210 and 211 are hinged to bars 212 and 213, which are linked to the crank device through axles. Details are not shown, as the principle should be known to any familiar with the art. It should be emphasized that the flywheel can be placed outside the crank and be linked to the rotating crank axle through a belt or chain as indicated in fig.

5. Fig. 20c illustrates how one can achieve an "uphill or downhill" training experience by changing the angle 215 of the cranks orbit. By adjusting the crank device's 214 angle on the training machine frame the elliptical orbit can be adjusted.

Fig. 21 shows a road going bike utilizing the invention. The crank assembly 220 replaces the common bicycle crank. The crank assembly is placed so that the crank arms 221 and 222 at their longest position points at about 45 degrees up and forward. This gives a rider a powerful weight arm when pedalling forward and down.

In the claims "pedal like" should be understood as all kind of pedals, platforms and other device for foot stepping or foot resting devices.

The invention described can be subject to modification and variations without thereby departing from the scope of the inventive concept. Moreover, all the details of the invention may be substituted by technically equivalent elements.

Claims:

1.

A crank device for use on a pedal like driven exercise machinery such as training equipment like elliptical machines, cross trainers, steppers, ergometer bikes, spinning bikes and road going bikes, where the crank arms each comprise of at least two parts, characterized in that the travel of the pedals form an elliptic orbit as the outer parts of the crank arms are rotate able counter wise of the inner parts of the crank arms.
(Fig. 1-2, 6-9, 12-13)

2.

A crank device for use on a pedal like driven machinery where the crank arms each comprise of at least two parts, characterized in that the travel of the pedals form an elliptic orbit as the outer parts of the crank arms are rotate able counter wise of the inner parts of the crank arms.
(Fig. 1-2, 6-9, 12-13)

3.

A crank device according to claim 1 and 2, characterized in that the inner crank arms are fixed together through an axle and the outer crank arms are fixed through axles to a first pair of gears rotate ably through the inner crank arms, and where the inner crank arms axle runs freely through a second pair of gears fixed non rotate able to a frame; the said first pair of gears linked/connected to the second pair of gears through a pair of chains making the said first pair of gears orbit the said second pair of gears when the outer crank arms are set in motion.
(Fig. 1-2, 6-8, 12-13)

4.

A crank device according to claim 1 and 2, characterized in that in that the inner crank arms are fixed together through an axle and the outer crank arms are fixed through axles to a first pair of gears rotate ably through the inner crank arms, and where the inner crank arms axle runs freely through a second pair of gears fixed non rotate able to a

frame; the said first pair of gears linked/connected to the second pair of gears through a third pair of gears placed between the first and second pair of gears, making the said first pair of gears orbit the said second pair of gears when the outer crank arms are set in motion.

(Fig. 9)

5.

A crank device according to claim 1-4, characterized in that the inner and outer crank arms fold parallel at two points of one rotation and stretches in line at two other positions of the rotation forming an elliptic orbit of the pedal end of the outer crank arms.

(Fig. 6)

6.

A crank device according to claim 3 and 4, characterized in that the ratio between the first gears and second gears are 1:2.

7.

A crank device according to claim 1-6, characterized in that pedals or platforms have means for controlling the angle through an orbit of the crank arms, the means consisting of a first gear attached to the pedal axle which is connected to a second gear attached to the outer crank axle through a chain and where the second gear is fixed on an axle through the inner crank arm to a third gear driven by a second chain fixed to a non rotate able gear on the frame.

(Fig. 11a-b, 12-13)

8.

A crank device according to claim 1-6, characterized in that the pedals have means for controlling the angle through an orbit of the crank arms, the means consisting of a first conic gear attached to the pedal axle which is connected to a second conic gear attached to the outer crank axle through a drive axle with conical gears and where the second

gear is fixed on an axle through the inner crank arm to a third gear driven by a second chain fixed to a non rotate able fourth gear on the frame.
(Fig. 11c-d)

9.
A crank device according to claim 7-8, characterized in that the ratio between the first, second, third and fourth gears are 1:1.

10.
A crank device according to claim 1-5, characterized in that the outer crank arm has a first gear linked non rotational to the inner crank arm where a first chain is connects the said first gear with a second gear rotational fixed to the outer crank arm, the second gear having means for attachment of pedal like devices.
(Fig. 12-13)

11.
A crank device according to claim 10, characterized in that the second gear on the outer crank arm has a third gear driving by means of a second chain, a forth gear rotational fixed to the outer crank arm, the fourth gear having means for attachment of pedal like devices.
(Fig. 12-13)

12.
A crank device according to claim 10, characterized in that the ratio between the first gear and second gear are 1:2.
(Fig. 12-13)

13.
A crank device according to claim 1-9, characterized in that the size of the orbit of the pedal end of the outer crank arms are adjustable by means of;

- outer crank arms with a number of fitting holes for the pedal.
- outer crank arms with oil pressurized cylinders with fittings for the pedal.

outer crank arms with threaded bolts with fittings for the pedal.

(Fig. 6, 14)

14.

A crank device according to claim 13, characterized in that the outer crank arm is adjustable in length and the axle for controlling the angle of pedal is telescopic for length adjustments.

(Fig. 15)

15.

A crank device according to claim 13-14, characterized in that the size of the orbit of the pedal end of the outer crank arms are automatically adjustable depending on speed of crank rotation and of pedal travel, where a system comprising of sensors, processing means like a cpu and power, where signals are created to an engine or pumps so to drive oil pressurized cylinders or threaded bolts mounted on outer crank arms to adjust the length to pedal fitting.

(Fig. 16)

16.

A crank device according to claim 15, characterized in that the size of the orbit of the pedal end of the outer crank arms have means for user adjustments as display with a keypad or touchscreen for input of user values.

(Fig. 16)

14.

A crank device according to claim 8, characterized in that outer crank arm has pedals or platforms with a tilt motion transverse to the axis of pedal or platform rotation, and where the tilt motion is adjustable.

(Fig. 17-18)

15.

A crank device according to claim 1-5, 7-8, 10-11, characterized in that the centre crank axle is fixed through a first wheel which through means drives a flywheel positioned between the crank arms and rotate able round the centre crank axle and where the drive means comprise a second wheel tensioned to the first wheel through a second axle connected to a third wheel which has a belt or chain for distributing rotation of the crank to the flywheel.

(Fig. 1-4)

16.

A crank device according to claim 15, characterized in that the centre crank axle is fixed through a first wheel which through means drives a flywheel positioned parallel to the first wheel and where the drive means comprise a second wheel tensioned to the first wheel through a second axle connected to a third wheel which has a belt or chain for distributing rotation of the crank to the flywheel.

(Fig. 5)

17.

A crank device according to claim 15-16, characterized in that the flywheel has braking means from one of the following kind:

- belt
- brake shoes
- electro magnetic

(Fig. 3-5)

18.

A crank device according to claim 1-17, characterized in that the device is connected with a flywheel mounted on a frame having handles forming a training machine.

(Fig. 19)

19.

A crank device according to claim 1-17, characterized in that the device is connected with a flywheel mounted on a frame having handles, where one end of a pair of bars are connected to a circular moving part of the crank device and the other end of the bars are hinged to handles forming a training machine where the handles move in a transverse movement to the pedals.

(Fig. 20a-b)

20. A crank device according to claim 18-19, characterized in that the crank device is adjustable to the frame so the angle of the orbit, relative to a neutral horizontal position of the elliptic orbit, achieves an upright or downright position.

(Fig. 20c)

21.

A crank device according to claim 1-5, characterized in that the device is mounted on a road going bike where at least one gear connected to the main axle between the crank arms drives the rear wheel through means of a chain.

(Fig. 21)

Summary:

A crank device for use on a pedal like driven exercise machinery such as training equipment like elliptical machines, cross trainers, ergometer bikes, spinning bikes and road going bikes, where the crank arms each comprise of two parts which in motion gives the pedals a travel in an elliptic orbit as the outer parts of the crank arms are rotate able counter wise of the inner parts of the crank arms.

(Fig. 1a)

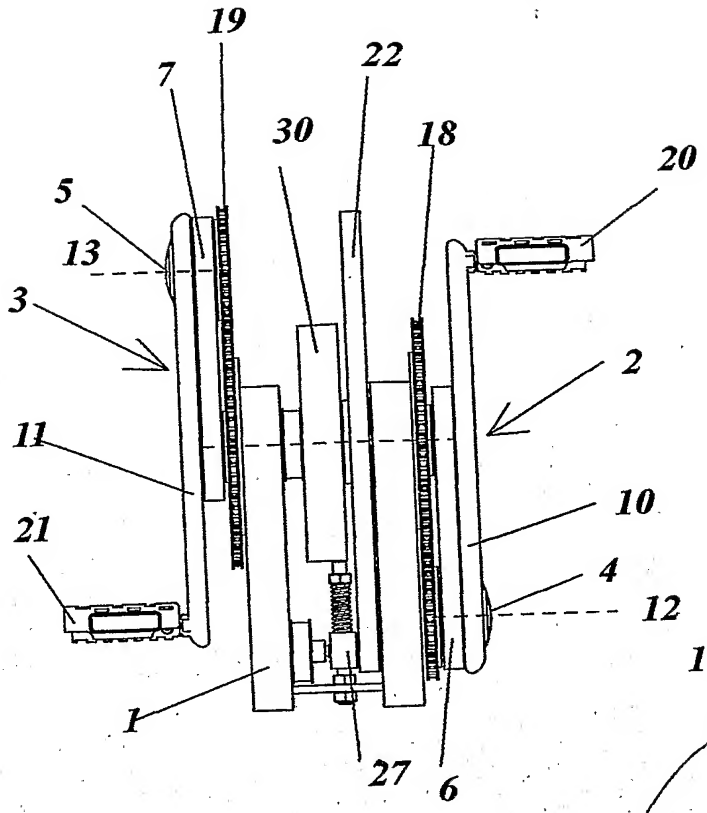

Fig. 1a

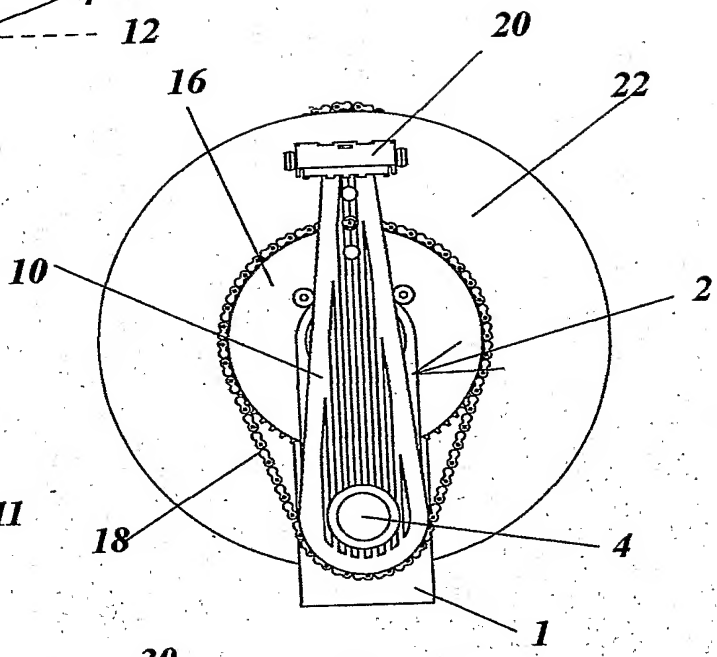

Fig. 1b

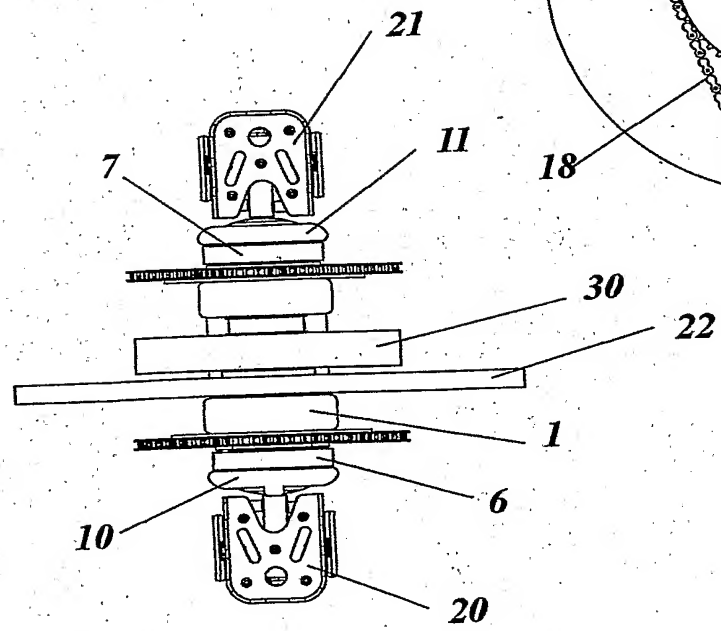

Fig. 1c

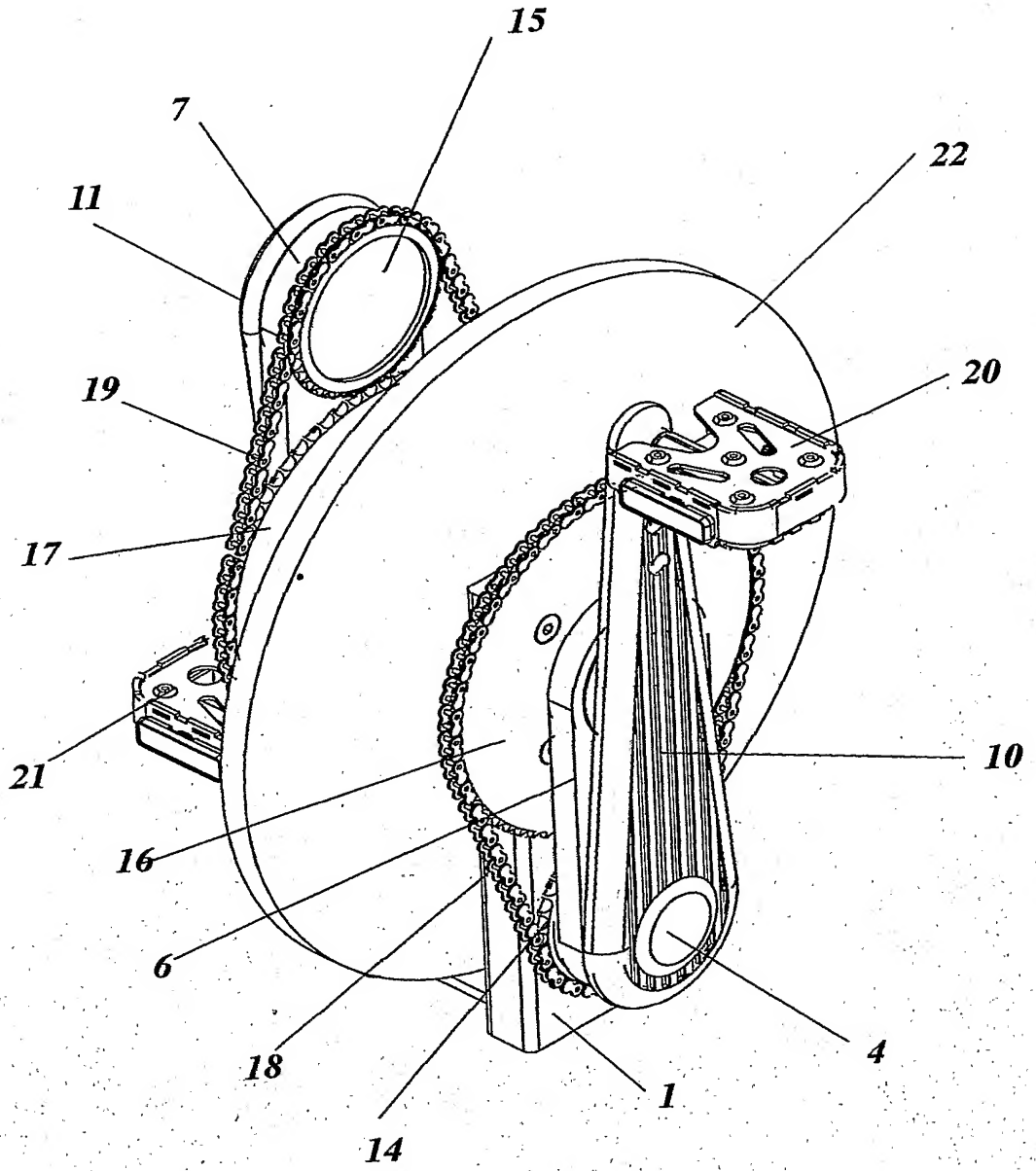

Fig. 2

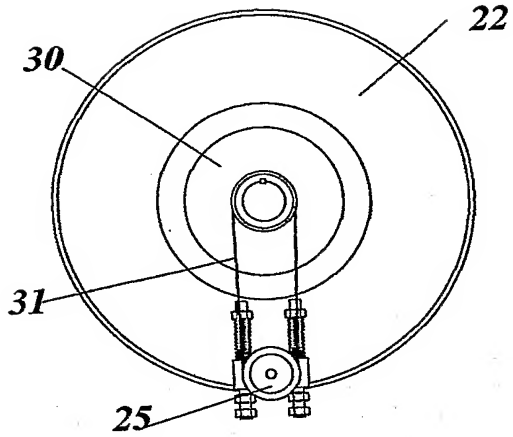

Fig 3a

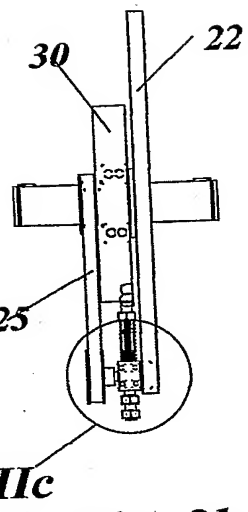

Fig. 3b

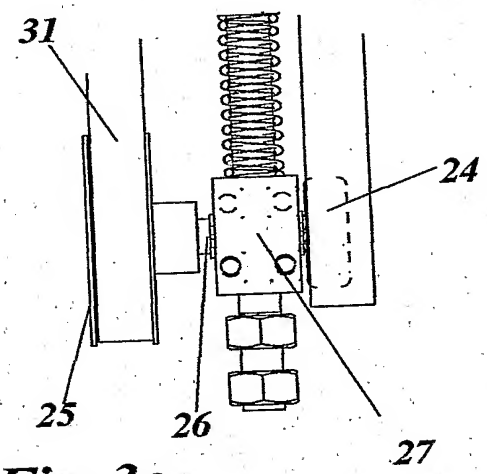

Fig. 3c

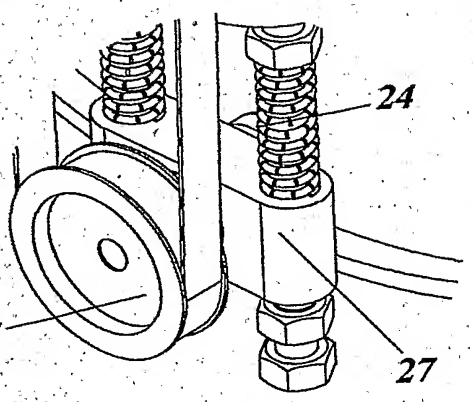

Fig. 3d

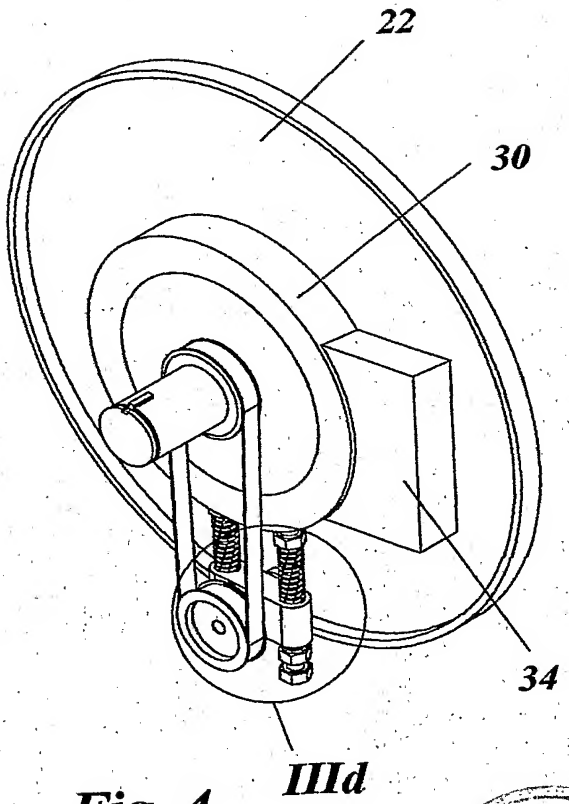

Fig. 4

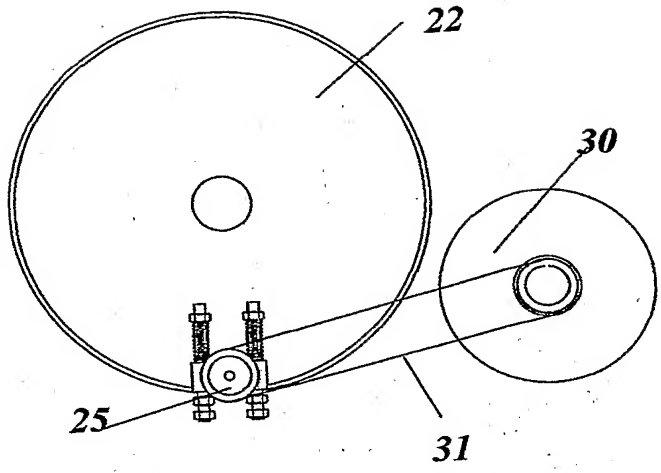

Fig. 5a

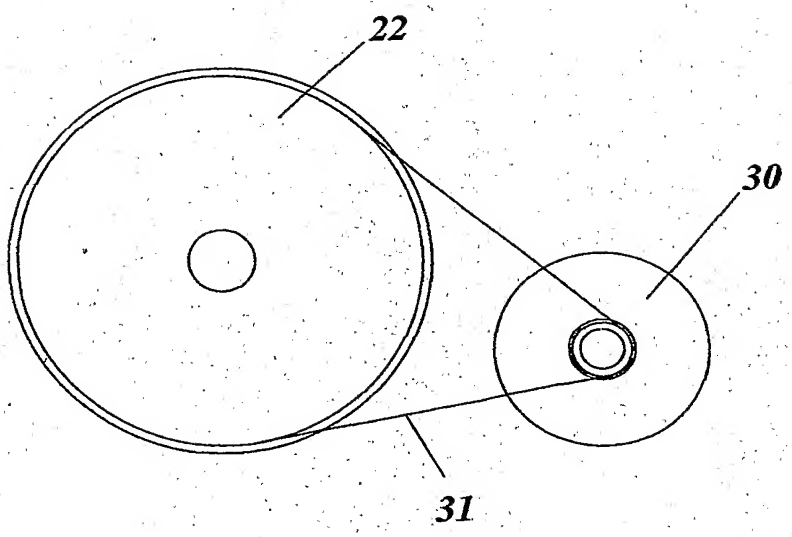

Fig. 5b

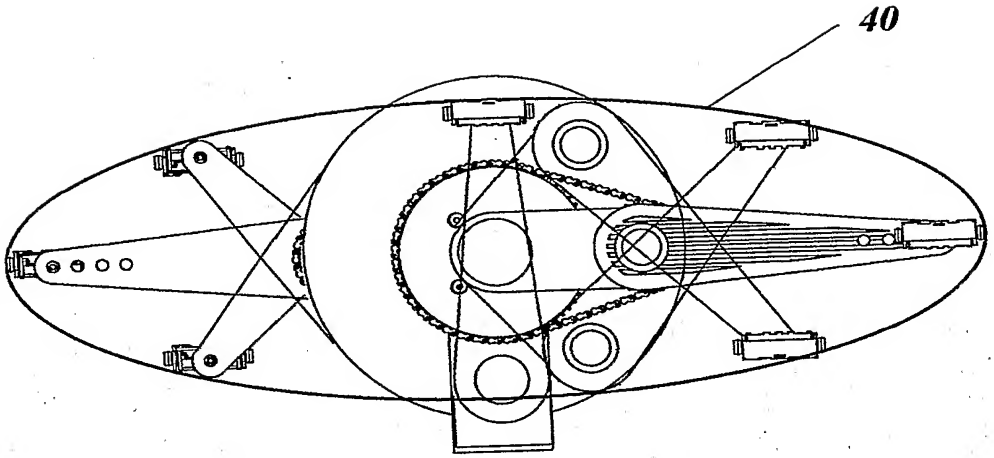

Fig. 6a

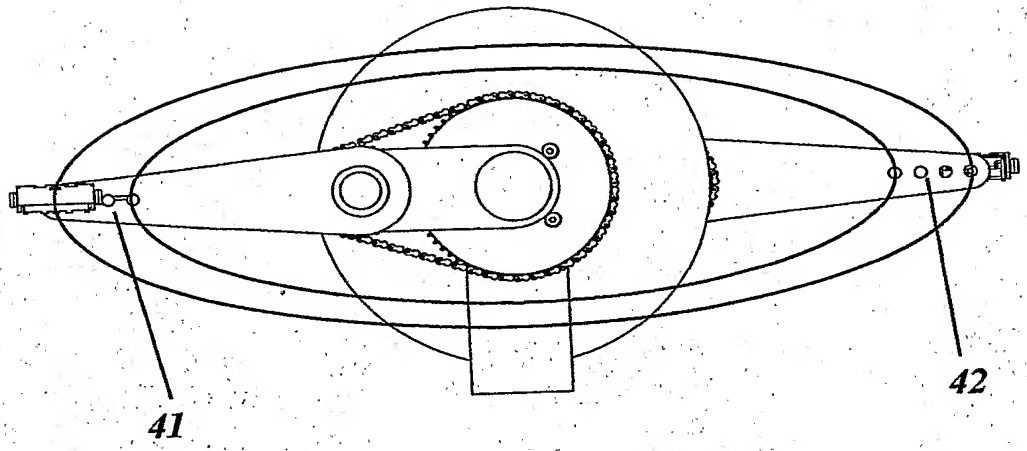

Fig. 6b

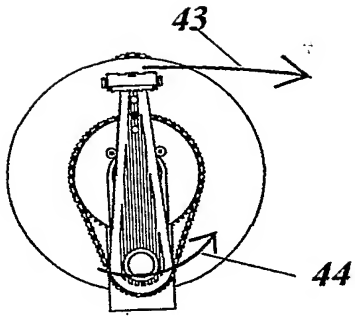

Fig. 7a

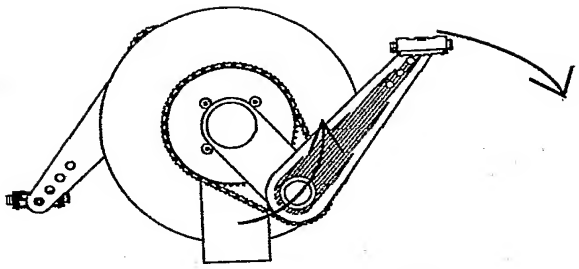

Fig. 7b

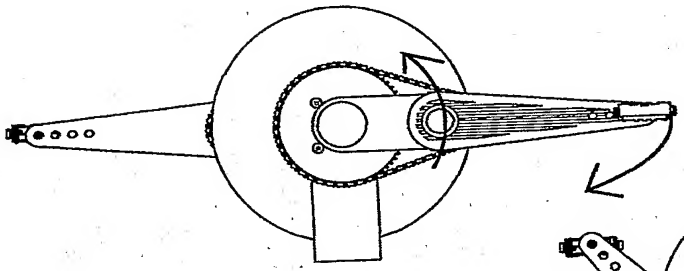

Fig. 7c

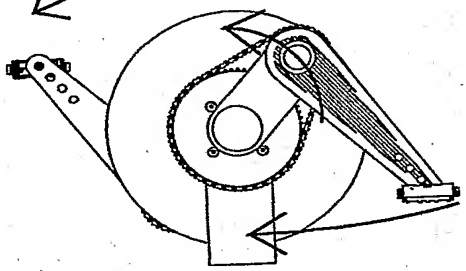

Fig. 7d

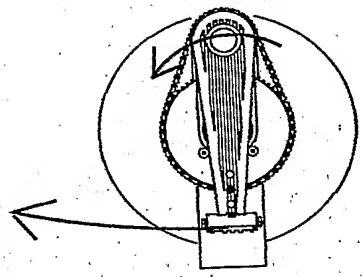

Fig. 7e

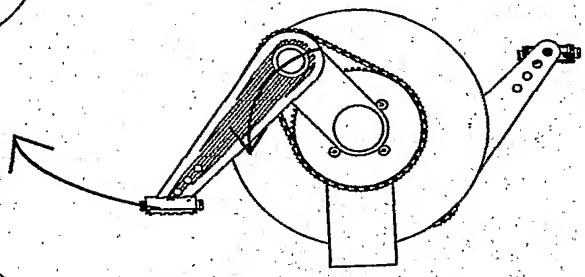

Fig. 7f

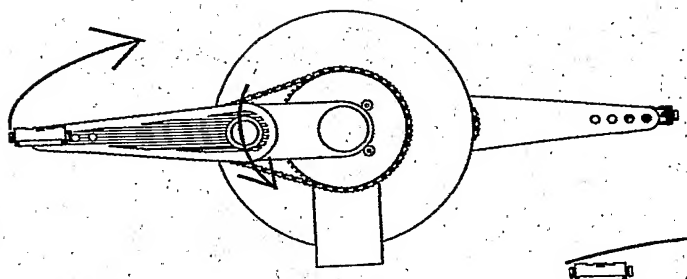

Fig. 7g

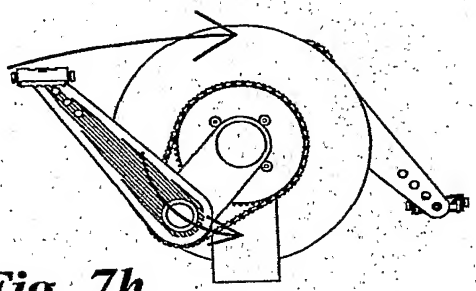

Fig. 7h

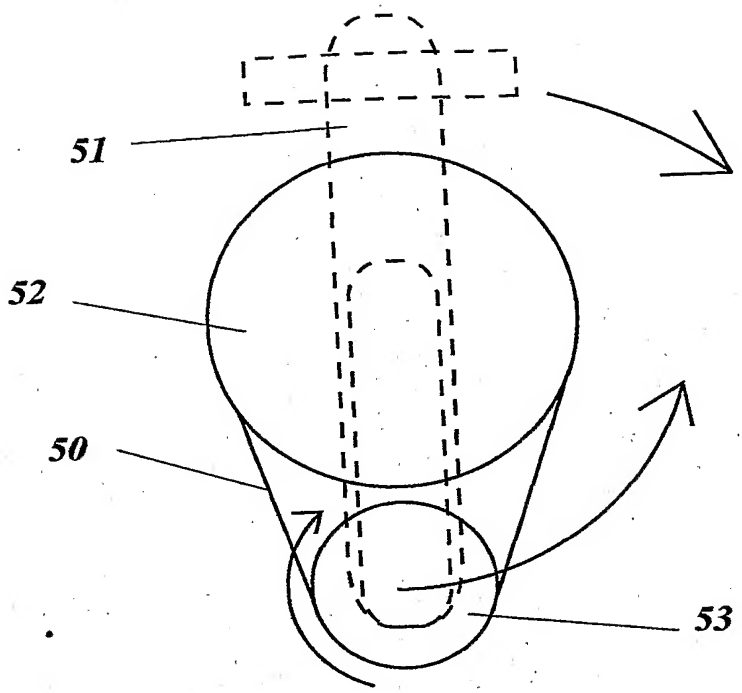

Fig. 8

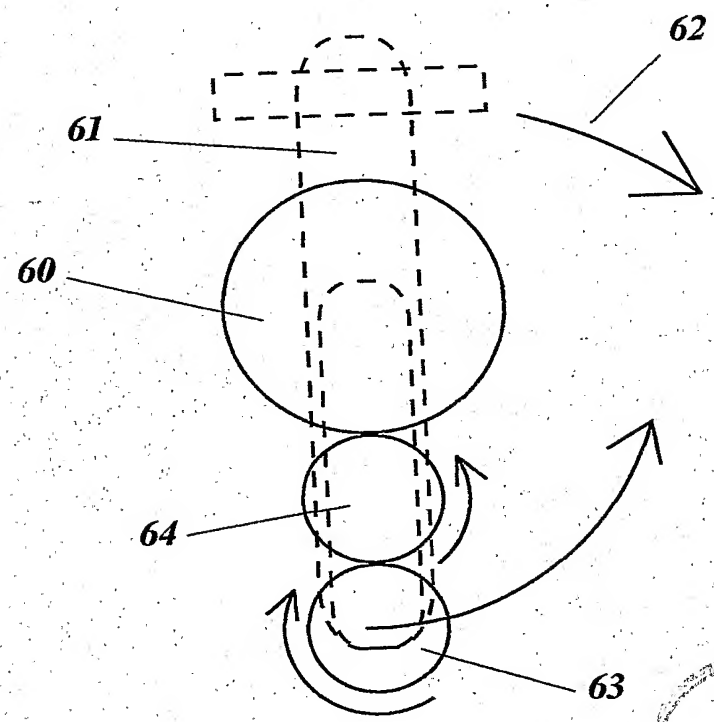

Fig. 9

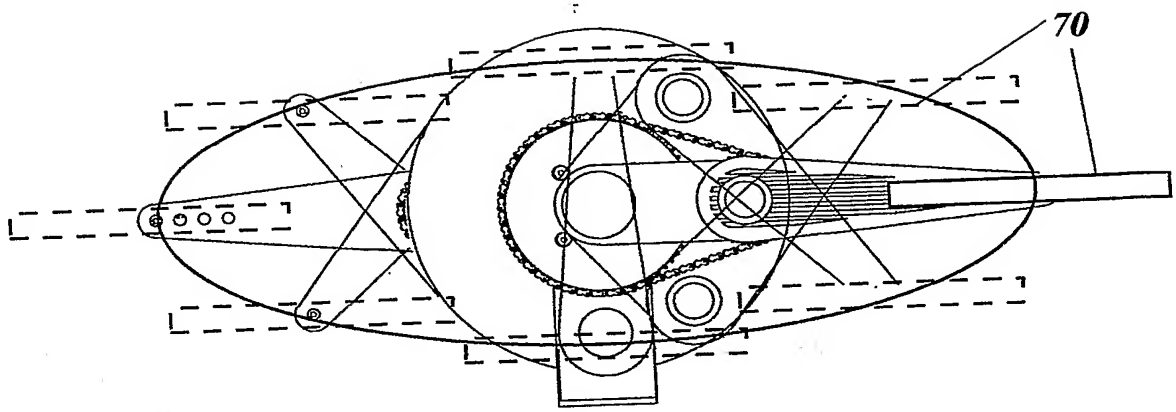

Fig. 10

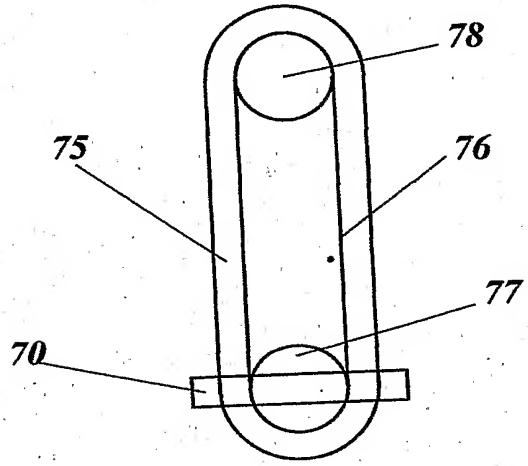

Fig. 11a

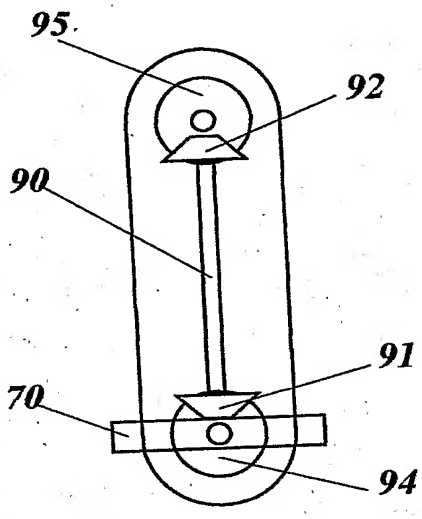

Fig. 11c

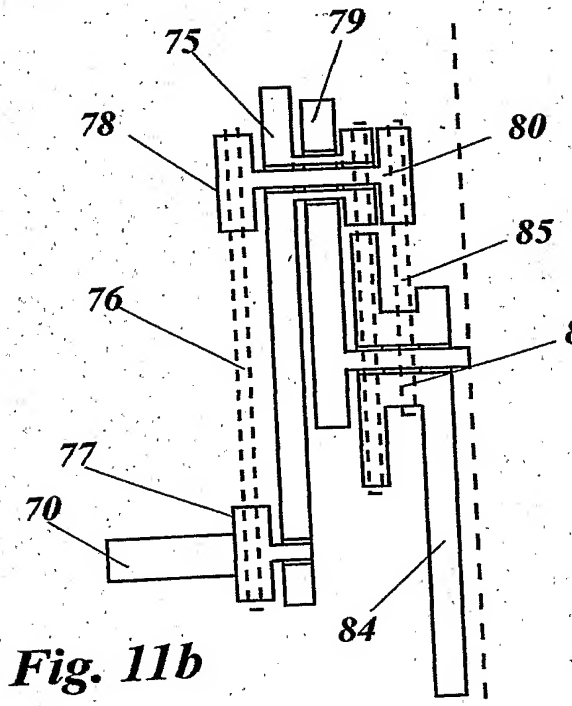

Fig. 11b

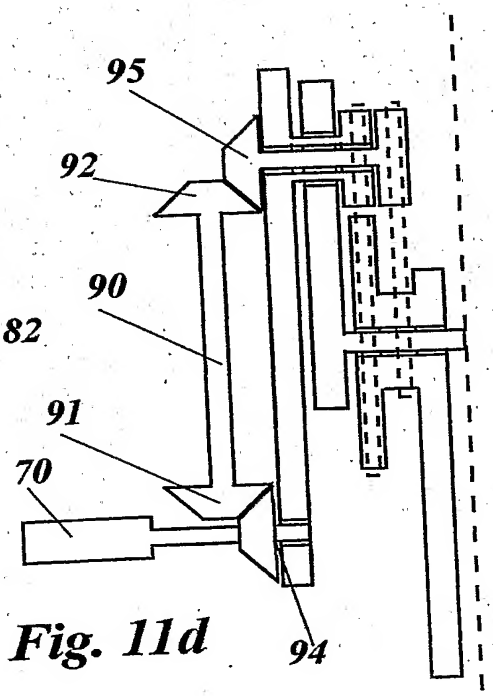

Fig. 11d

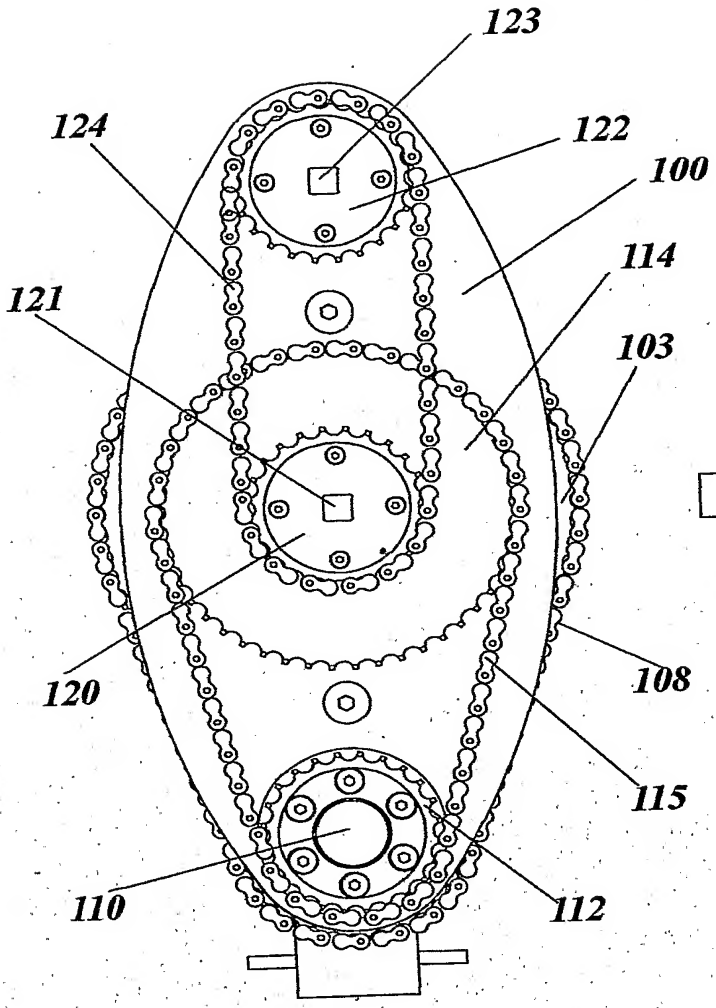

Fig. 12a

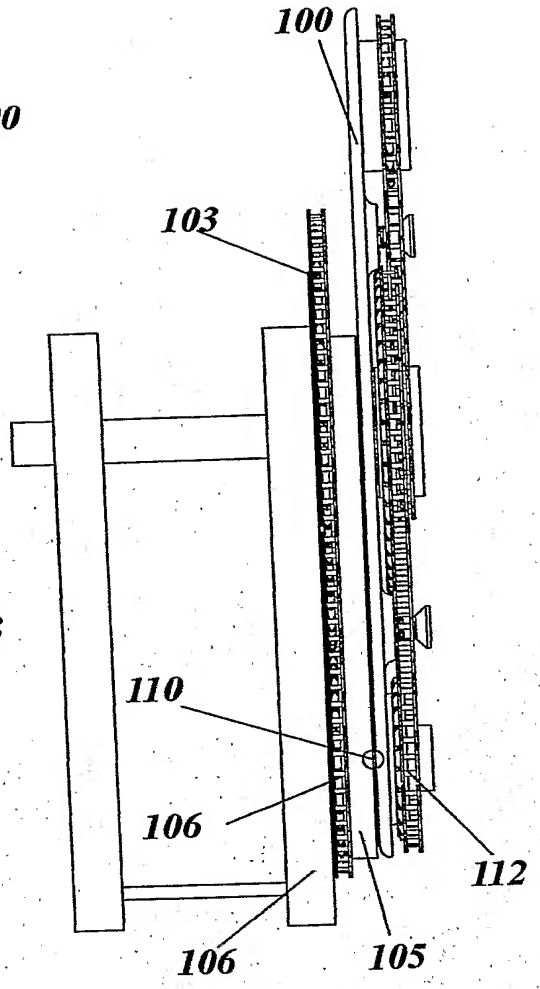

Fig. 12b

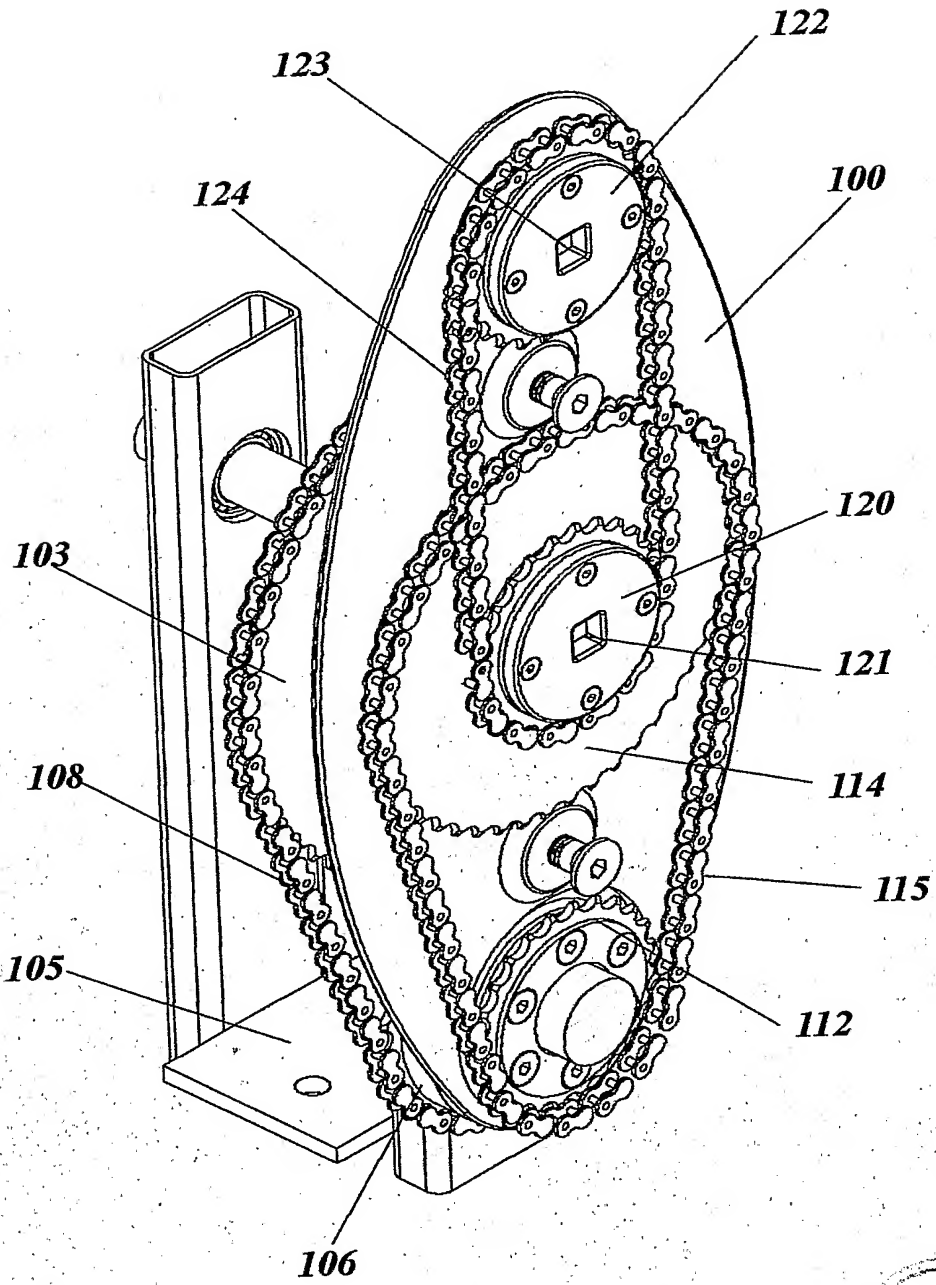

Fig. 13

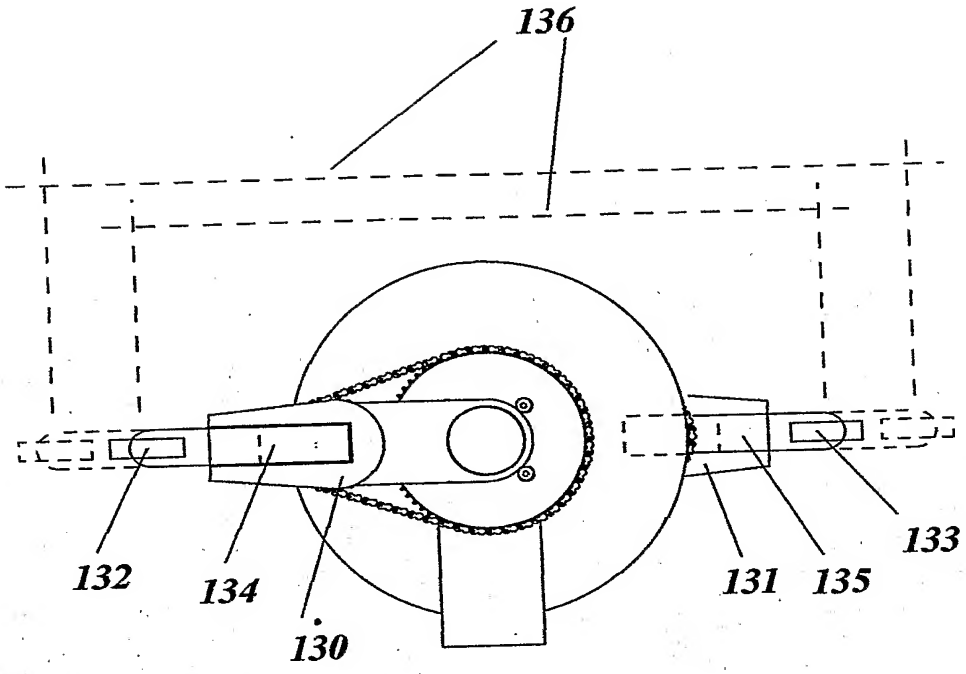

Fig. 14a

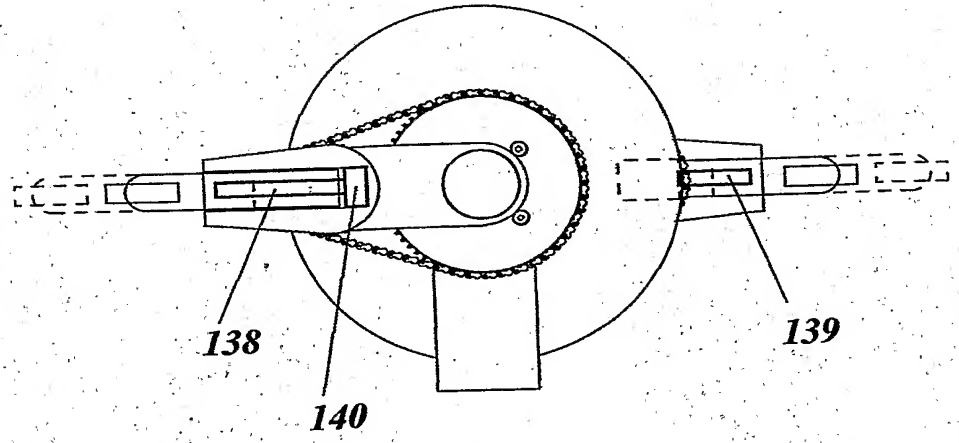

Fig. 14b

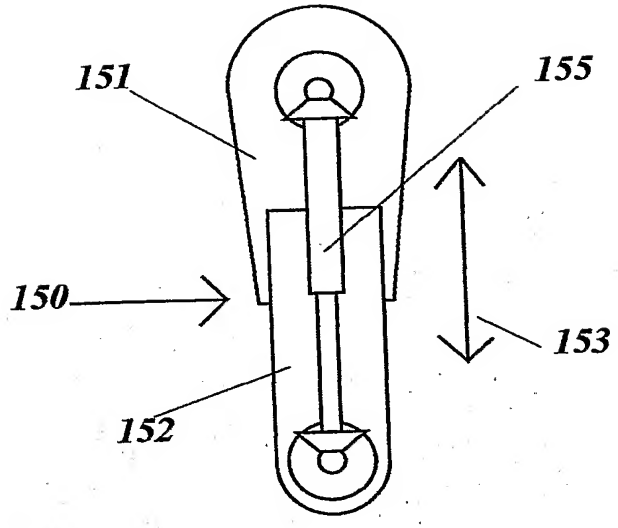

Fig. 15a

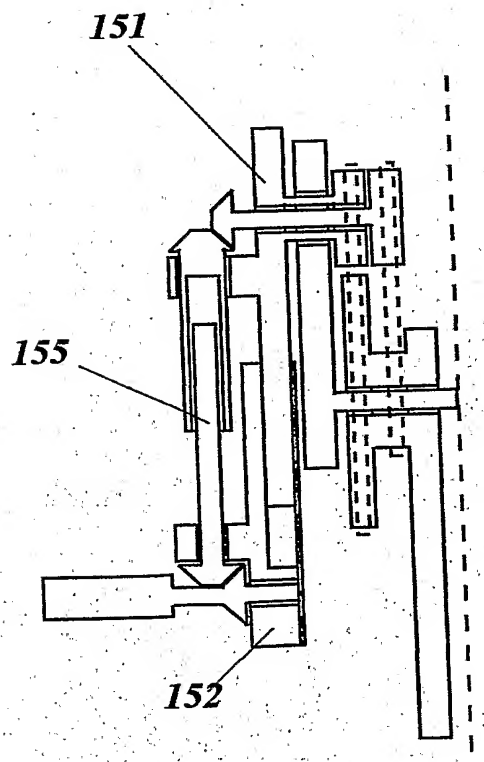

Fig. 15b

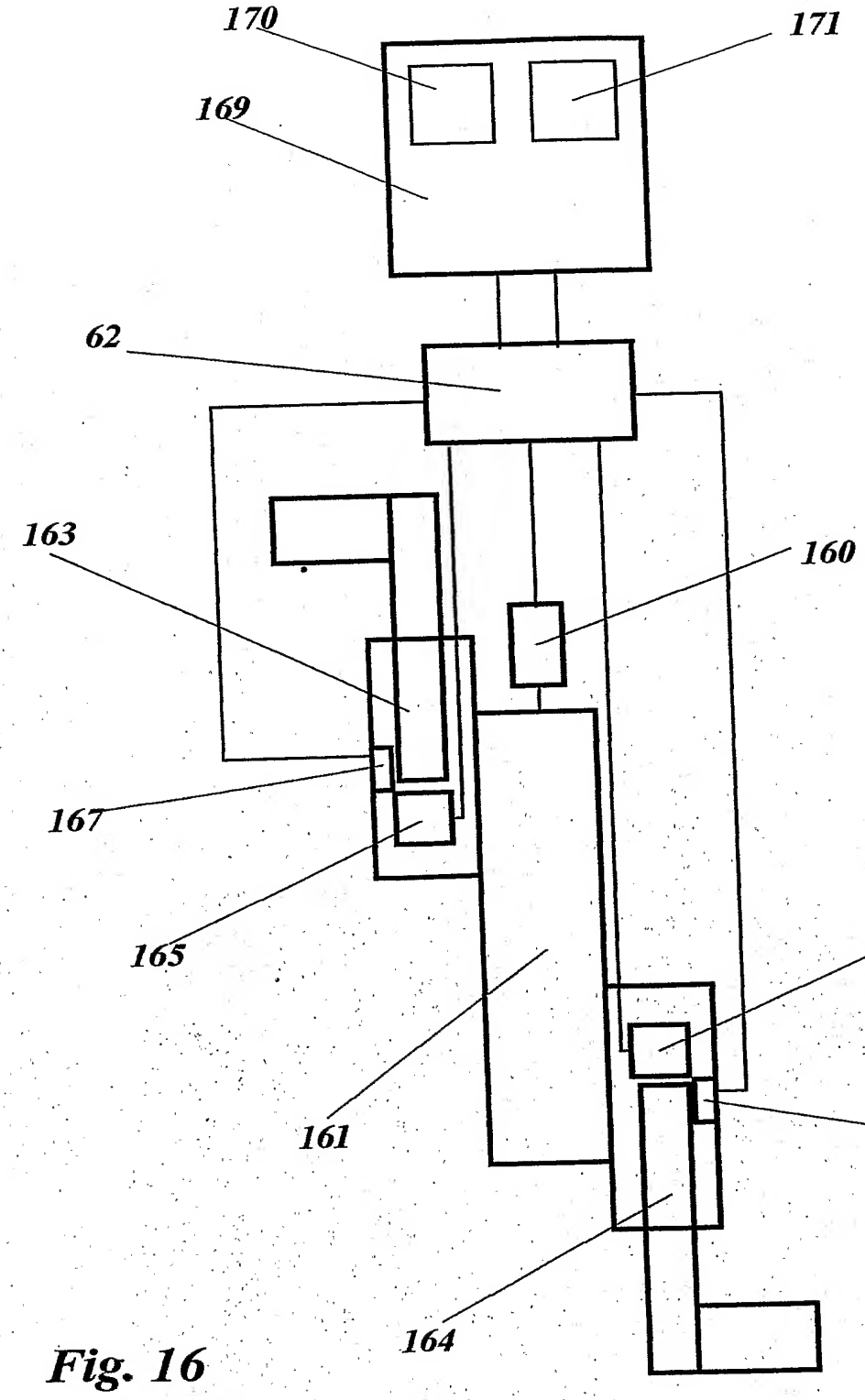

Fig. 16

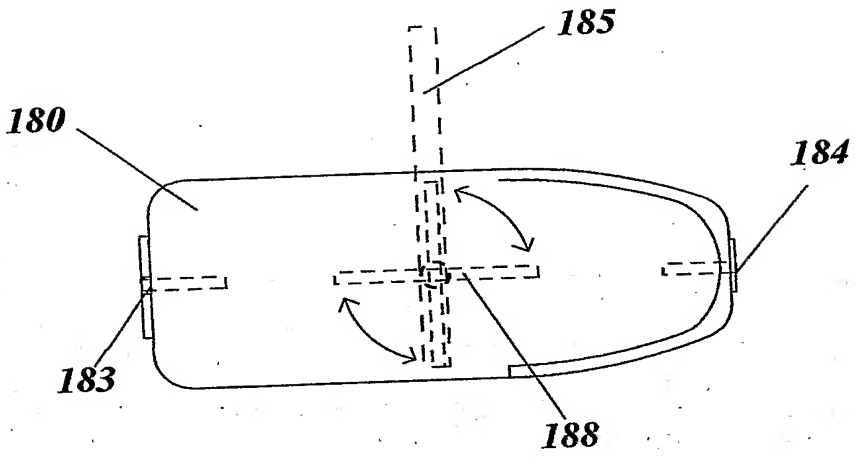

Fig. 17a

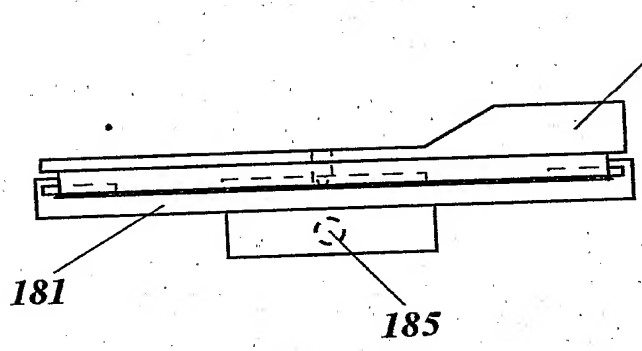

Fig. 17b

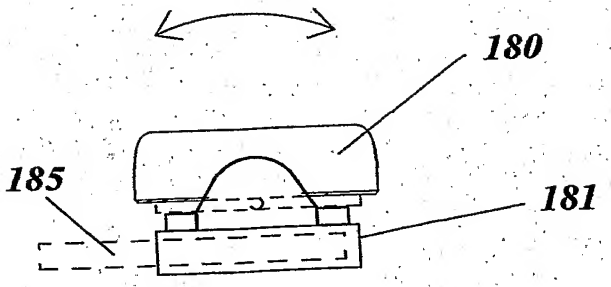

Fig. 17c

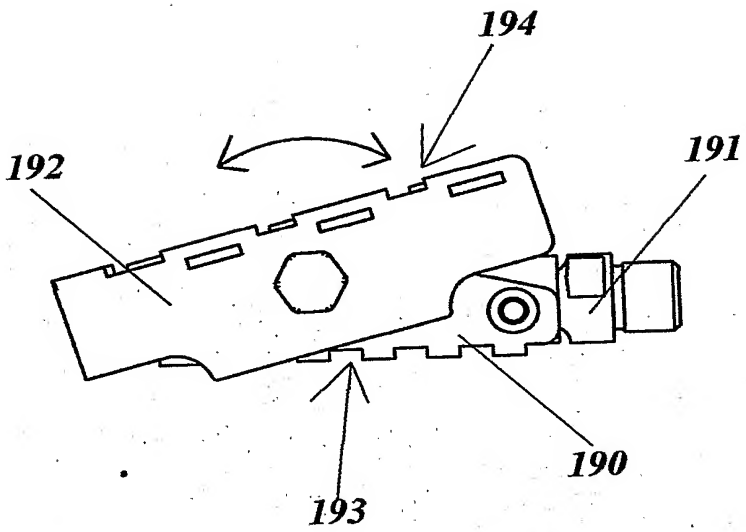

Fig. 18a

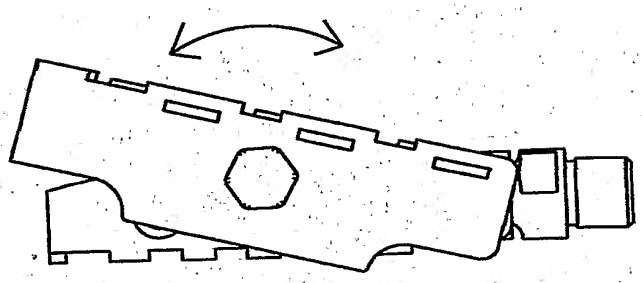

Fig. 18b

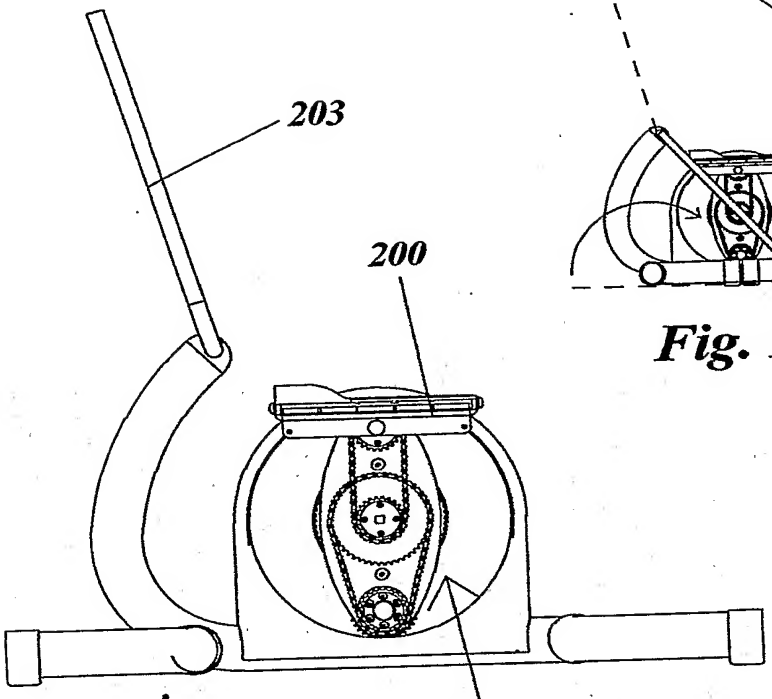

Fig. 19a

Fig. 19c

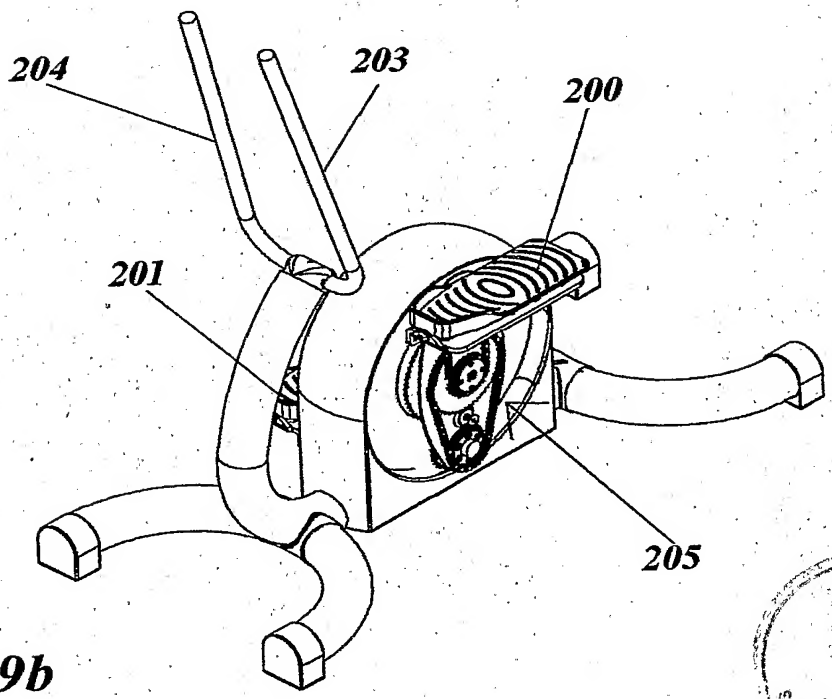

Fig. 19b

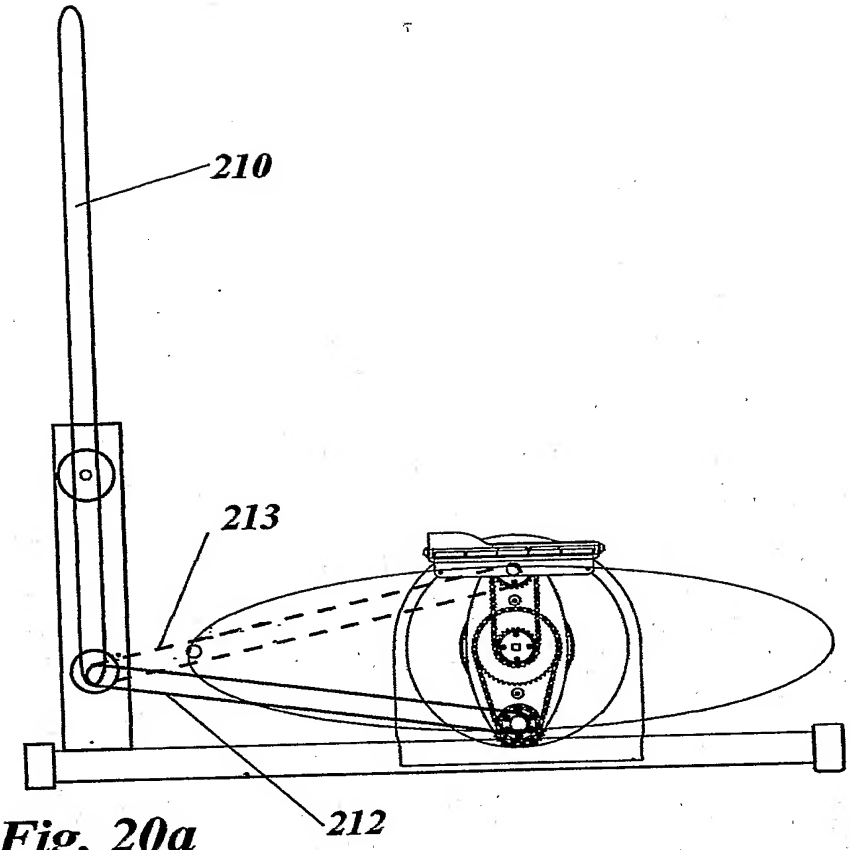

Fig. 20a

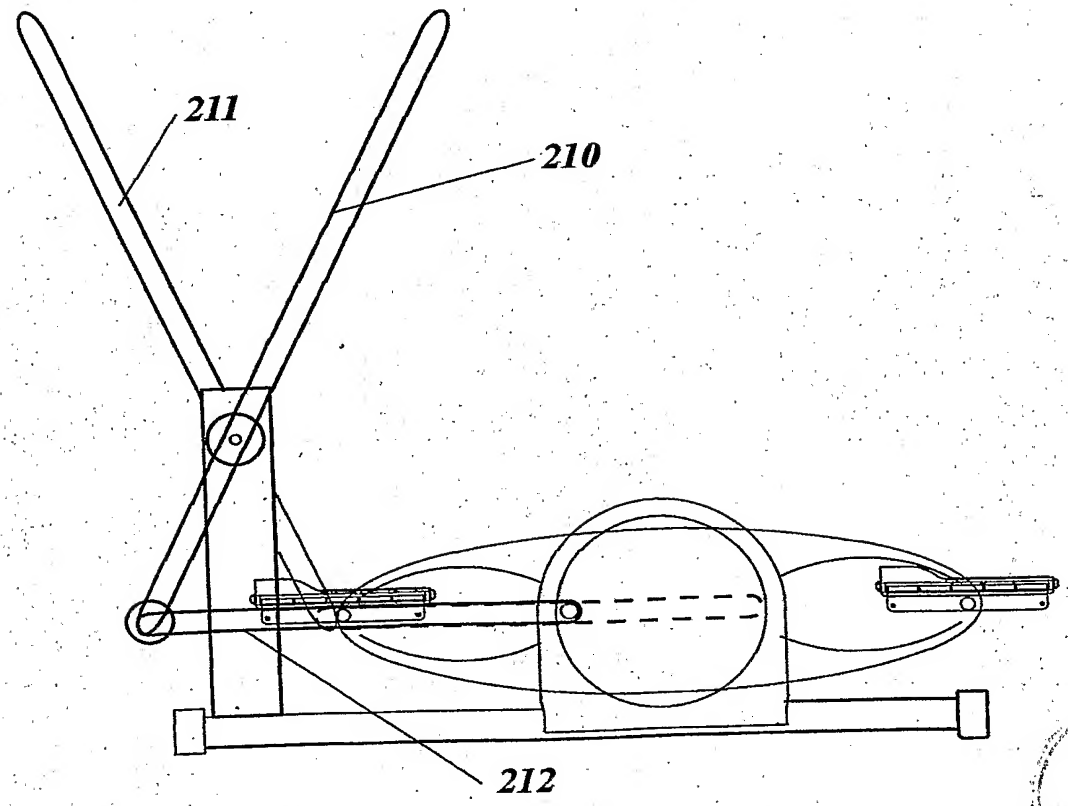

Fig. 20b

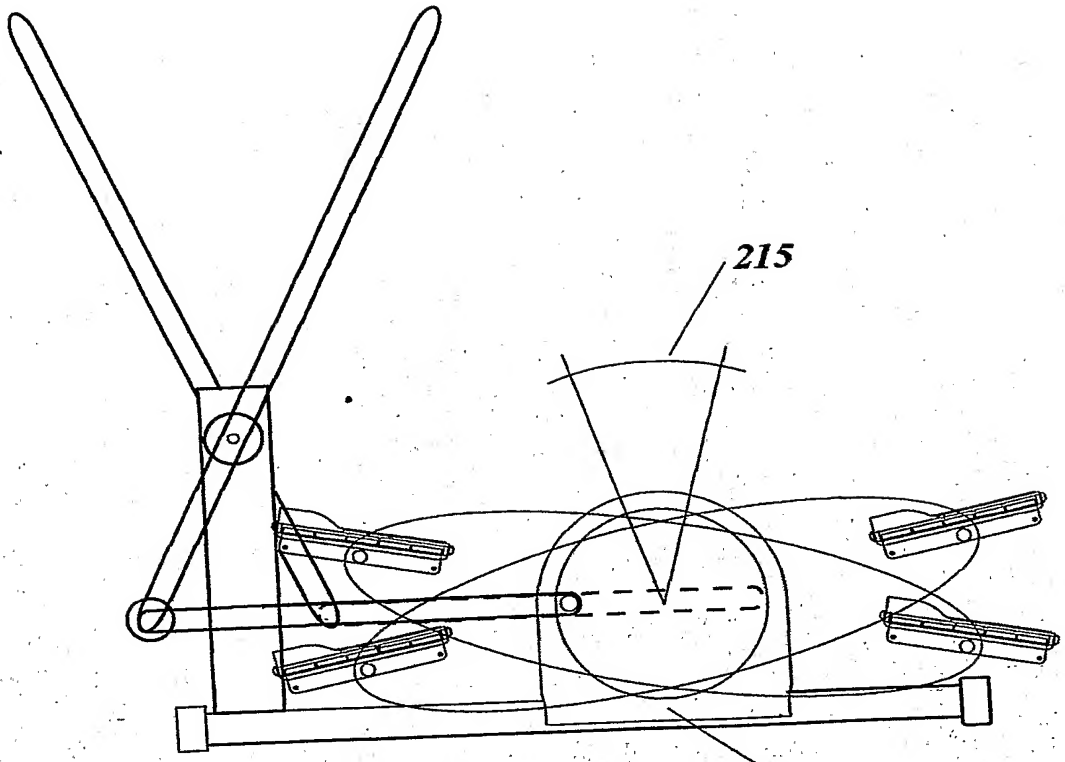

Fig. 20c

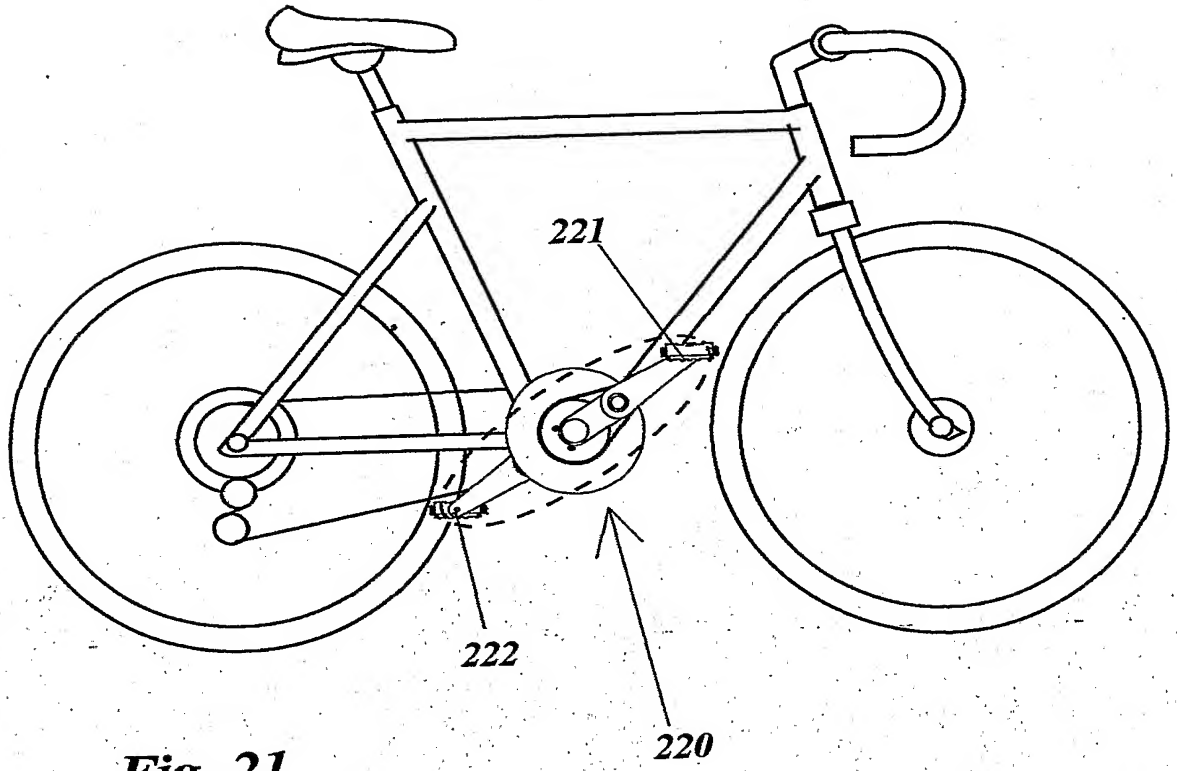

Fig. 21